

Appl. No. : 10/766068
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AMENDMENTS TO THE CLAIMS

Please amend the Claim Form and Claim as follows. Insertions are shown underlined while deletions are ~~struck-through~~.

1 (currently amended): A method of measuring a concentration of a specific substance contained in a measurement sample by use of a chemical sensor comprising at least a working electrode and a reference electrode, wherein

the method is a measurement method according to such a procedure that

the chemical sensor is immersed into a buffer solution of a predetermined composition used as a storage liquid during standby, and a predetermined measurement bias is applied between the working electrode and the reference electrode to hold the chemical sensor in the buffer solution, and

the chemical sensor is immersed into the measurement sample instead of the buffer solution, and the measurement bias applied between the working electrode and the reference electrode is used to measure the concentration of the specific substance contained in the measurement sample based on a change in an amount of a current produced by an electrochemical reaction during measurement; and

the method comprising the following procedure for initial treatment, at the stage of making first use of the chemical sensor;:

as a first bias application after immersing the chemical sensor kept under a dry state into the buffer solution to bring the surfaces of the working electrode and reference electrode into contact with the buffer solution;

a first initial treatment step of applying a first initial treatment bias having the same direction as that of the measurement bias and possessing an absolute value larger than that of the measurement bias between the working electrode and the reference electrode to hold the chemical sensor in the buffer solution for a predetermined first initial treatment time;

a second initial treatment step of changing the bias to be applied between the working electrode and a-the reference electrode to a second initial treatment bias which is the same as the measurement bias, after ending the first initial treatment step, while the chemical sensor is immersed in the buffer solution, and holding the chemical sensor in a standby state; and

Appl. No. : 10/766068
Filed : January 28, 2004

after the completion of the second initial treatment step, the chemical sensor is placed for the first time at the use for measurement of the measurement sample,

wherein any bias applied between the working electrode and the reference electrode during said procedure for initial treatment has the same direction as that of the measurement bias.

2 (original): The method according to claim 1, wherein, after ending the first initial treatment step, in the second initial treatment step, the chemical sensor is held in the standby state for a predetermined second initial treatment time.

3 (currently amended): The method according to claim 2, wherein the chemical sensor further comprises a counter electrode, the working electrode, and the reference electrode,

the counter electrode in addition to the working electrode and the reference electrode,

the reference electrode is constituted of a material having a predetermined chemical potential difference from the working electrode, when brought into contact with the buffer solution,

the reference electrode is used as a reference to set the bias for the working electrode in such a manner that a desired bias is applied between the working electrode and the reference electrode in the steps of applying the measurement bias, the first initial treatment bias, and the second initial treatment bias, and

the steps of applying the measurement bias, the first initial treatment bias, and the second initial treatment bias are set respectively in such a manner that the difference between the biases of the reference electrode and working electrode in the buffer solution imparts the bias difference in accordance with the measurement bias, the first initial treatment bias, and the second initial treatment bias.

4 (original): The method according to claim 3, wherein a silver/silver chloride electrode is used as the reference electrode, and a platinum electrode is used for the working electrode and the counter electrode, and

said measurement bias applied between the working electrode and the reference electrode during the measurement is an applied bias obtained by the bias of the working electrode selected from a range of 400 to 700 mV on the datum basis of the silver/silver chloride electrode used as the reference electrode in the buffer solution.

Appl. No. : 10/766068
Filed : January 28, 2004

5 (currently amended): The method according to claim 3, wherein in the first initial treatment step,

an applied bias at which an electrolysis reaction of water starts on the working electrode and the counter electrode in the buffer solution is defined as an applied bias upper limit value, and the measurement bias is defined as an applied bias lower limit value on the datum basis of the silver/silver chloride electrode used as the reference electrode, respectively; and

by using an upper/lower limit bias difference defined by a difference between the applied bias upper and lower limit values, the first initial treatment bias applied between the working electrode and the reference electrode is selected in a range of the applied bias which is larger than the measurement bias by 10% or more of the upper/lower limit bias difference and which is smaller than the applied bias upper limit value by at least 200 mV or more.

6 (currently amended): The method according to claim 4, wherein ~~in the case where a silver/silver chloride electrode is used as the reference electrode, and a platinum electrode is used for the working electrode and the counter electrode;~~

in the first initial treatment step,

the first initial treatment bias applied between the working electrode and the reference electrode is selected in a range of the applied bias which is larger than the measurement bias by at least 100 mV or more and which does not exceed 900 mV on the datum basis of the silver/silver chloride electrode used as the reference electrode in the buffer solution.

7 (currently amended): The method according to claim 4, wherein ~~in the case where a silver/silver chloride electrode is used as the reference electrode, and a platinum electrode is used for the working electrode and the counter electrode;~~

in the first initial treatment step,

the first initial treatment bias applied between the working electrode and the reference electrode is selected in a range of at least 750 mV to 900 mV on the datum basis of the silver/silver chloride electrode used as the reference electrode in the buffer solution, and the first initial treatment time is selected in a range of four hours or less and at least not less than one hour.

8 (original): The method according to claim 4, wherein said second initial treatment time is selected at least in a range of not less than one hour.

Appl. No. : 10/766068
Filed : January 28, 2004

9 (original): The method according to claim 8, wherein a total of the first initial treatment time and the second initial treatment time is selected in a range of six hours or less.

10 (currently amended): The method according to claim 3, wherein said chemical sensor is an amperometric chemical sensor which has three electrodes including the counter electrode in addition to the working electrode and the reference electrode, wherein

the working electrode, counter electrode, and reference electrode are all formed on an insulating substrate, and

an enzyme electrode comprising at least an immobilized enzyme film layer disposed on the surface of the working electrode is used for the current detection.

11 (currently amended): A method of measuring a concentration of a specific substance contained in a measurement sample by use of a chemical sensor having at least a working electrode and a reference electrode, wherein

the method is a measurement method according to such a procedure that

the chemical sensor is immersed into a buffer solution of a predetermined composition used as a storage liquid during standby, and a predetermined measurement bias is applied between the working electrode and the reference electrode to hold the chemical sensor in the buffer solution, and

the chemical sensor is immersed into the measurement sample instead of the buffer solution, and the measurement bias applied between the working electrode and the reference electrode is used to measure the concentration of the specific substance contained in the measurement sample based on a change in an amount of a current produced by an electrochemical reaction during measurement; and

the method comprising the following procedure for refresh treatment, at every stage post to continued use of the chemical sensor for a predetermined period,

as a first bias application in a condition in which the chemical sensor in a standby state is immersed in the buffer solution, and the surfaces of the working electrode and reference electrode are allowed to contact the buffer solution;

a first refresh treatment step of applying a first refresh treatment bias having the same direction as that of the measurement bias and possessing an absolute value larger than that of the

Appl. No. : 10/766068
Filed : January 28, 2004

measurement bias between the working electrode and the reference electrode, and holding the chemical sensor in the buffer solution for a predetermined first refresh treatment time;

a refresh standby treatment step of changing the bias applied between the working electrode and the reference electrode to a second refresh treatment bias which is the same as the measurement bias, after ending the first refresh treatment step, while the chemical sensor is immersed in the buffer solution, and holding the chemical sensor in a standby state for a second refresh treatment time; and

after completion of the refresh standby treatment step, the chemical sensor is placed again at the use for the measurement of the measurement sample,

wherein any bias applied between the working electrode and the reference electrode during said procedure for refresh treatment has the same direction as that of the measurement bias.

12 (currently amended): A chemical sensor type measuring apparatus being capable of measuring operation in accordance with the measuring method by use of a chemical sensor as claimed in claim 2, the apparatus comprising:

a chemical sensor having at least a working electrode and a reference electrode;

a signal detection circuit including at least means for applying a bias between the working electrode and the reference electrode, and means for detecting a signal measured by the chemical sensor; and

the apparatus further comprising

a notification device used for the following procedure for initial treatment at the stage of making first use of the chemical sensor,

wherein the procedure for initial treatment comprising:

as a first bias application after immersing the chemical sensor kept under a dry state into the buffer solution to bring the surfaces of the working electrode and reference electrode into contact with the buffer solution,

a first initial treatment step of applying a first initial treatment bias having the same direction as that of the measurement bias and possessing an absolute value larger than that of the measurement bias between the working electrode and the reference electrode to hold the chemical sensor in the buffer solution for a predetermined first initial treatment time;

Appl. No. : 10/766068
Filed : January 28, 2004

a second initial treatment step of changing the bias to be applied between the working electrode and the reference electrode to a second initial treatment bias which is the same as the measurement bias, after ending the first initial treatment step, while the chemical sensor is immersed in the buffer solution, and holding the chemical sensor in a standby state; and

after the completion of the second initial treatment step, the chemical sensor is placed for the first time at the use for measurement of the measurement sample,

wherein any bias applied between the working electrode and the reference electrode during said procedure for initial treatment has the same direction as that of the measurement bias, and

the notification device comprising:

a system for adjusting the bias to be applied applying a first initial treatment bias having the same direction as that of the measurement bias and possessing an absolute value larger than that of the measurement bias between the working electrode and the reference electrode to the first initial treatment for the predetermined first initial treatment time in a condition in which the chemical sensor kept under a dry state is immersed in a buffer solution to allow the surfaces of the working electrode and a reference electrode to contact the buffer solution at the stage of making first use of the chemical sensor;

a system for adjusting changing the bias to be applied between the working electrode and the reference electrode to a second initial treatment bias which is the same as the measurement bias to apply the second initial treatment bias for the predetermined second initial treatment time, while the chemical sensor is continuously immersed in the buffer solution; and

a system for notifying that the chemical sensor is ready to apply for measurement thereafter at the time of end of said two-step initial treatment operation.

13 (currently amended): A chemical sensor type measuring apparatus being capable of measuring operation in accordance with the measuring method by use of a chemical sensor as claimed in claim 11, the apparatus comprising:

in which a measuring operation is possible in accordance with the measuring method by a chemical sensor according to claim 11, the apparatus comprising:

the chemical sensor having at least a working electrode and a reference electrode;

Appl. No. : 10/766068
Filed : January 28, 2004

a signal detection circuit including at least means for applying a bias between the working electrode and the reference electrode, and means for detecting a signal measured by the chemical sensor; and

the apparatus further comprising
a notification device used for the following procedure for refresh treatment at every stage post to continued use of the chemical sensor for a predetermined period,

wherein the procedure for refresh treatment comprises:
as a first bias application in a condition in which the chemical sensor in a standby state is immersed in the buffer solution, and the surfaces of the working electrode and reference electrode are allowed to contact the buffer solution;

a first refresh treatment step of applying a first refresh treatment bias having the same direction as that of the measurement bias and possessing an absolute value larger than that of the measurement bias between the working electrode and the reference electrode, and holding the chemical sensor in the buffer solution for a predetermined first refresh treatment time;

a refresh standby treatment step of changing the bias applied between the working electrode and the reference electrode to a second refresh treatment bias which is the same as the measurement bias, after ending the first refresh treatment step, while the chemical sensor is immersed in the buffer solution, and holding the chemical sensor in a standby state for a second refresh treatment time; and

after completion of the refresh standby treatment step, the chemical sensor is placed again at the use for the measurement of the measurement sample,

wherein any bias applied between the working electrode and the reference electrode during said procedure for refresh treatment has the same direction as that of the measurement bias,

the notification device comprising:
a system for adjusting applying a the first refresh treatment bias having the same direction as that of the measurement bias and possessing an absolute value larger than that of the measurement bias between the working electrode and the reference electrode for at the first refresh treatment time in a condition in which the chemical sensor in a standby state is immersed in the buffer solution, and the surfaces of the working electrode and reference electrode are allowed to contact a buffer solution at every use of the chemical sensor for a predetermined period;

Appl. No. : 10/766068
Filed : January 28, 2004

a system for adjusting changing the bias applied between the working electrode and the reference electrode to a second refresh treatment bias which is the same as the measurement bias, and applying the second refresh treatment bias for the second refresh treatment time, while the chemical sensor is continuously immersed in the buffer solution; and

a system for notifying that the chemical sensor is ready to apply again for measurement thereafter at the time of end of said two-step refresh treatment operation.

14 (previously presented): The method according to claim 4, wherein in the first initial treatment step,

an applied bias at which an electrolysis reaction of water starts on the working electrode and the counter electrode in the buffer solution is defined as an applied bias upper limit value, and the measurement bias is defined as an applied bias lower limit value on the datum basis of the silver/silver chloride electrode used as the reference electrode, respectively; and

by using an upper/lower limit bias difference defined by a difference between the applied bias upper and lower limit values, the first initial treatment bias applied between the working electrode and the reference electrode is selected in a range of the applied bias which is larger than the measurement bias by 10% or more of the upper/lower limit bias difference and which is smaller than the applied bias upper limit value by at least 200 mV or more.

15 (currently amended): The method according to claim 4, wherein said chemical sensor is an amperometric chemical sensor which has three electrodes including the counter electrode in addition to the working electrode and the reference electrode, wherein

the working electrode, counter electrode, and reference electrode are all formed on an insulating substrate, and

an enzyme electrode comprising at least an immobilized enzyme film layer disposed on the surface of the working electrode is used for the current detection.

16 (currently amended): The method according to claim 5, wherein said chemical sensor is an amperometric chemical sensor which has three electrodes including the counter electrode in addition to the working electrode and the reference electrode, wherein

the working electrode, counter electrode, and reference electrode are all formed on an insulating substrate, and

Appl. No. : 10/766068
Filed : January 28, 2004

an enzyme electrode comprising at least an immobilized enzyme film layer disposed on the surface of the working electrode is used for the current detection.

17 (currently amended): The method according to claim 6, wherein said chemical sensor is an amperometric chemical sensor-which has three electrodes including the counter electrode in addition to the working electrode and the reference electrode, wherein

the working electrode, counter electrode, and reference electrode are all formed on an insulating substrate, and

an enzyme electrode comprising at least an immobilized enzyme film layer disposed on the surface of the working electrode is used for the current detection.

18 (currently amended): The method according to claim 7, wherein said chemical sensor is an amperometric chemical sensor-which has three electrodes including the counter electrode in addition to the working electrode and the reference electrode, wherein

the working electrode, counter electrode, and reference electrode are all formed on an insulating substrate, and

an enzyme electrode comprising at least an immobilized enzyme film layer disposed on the surface of the working electrode is used for the current detection.

19 (currently amended): The method according to claim 8, wherein said chemical sensor is an amperometric chemical sensor-which has three electrodes including the counter electrode in addition to the working electrode and the reference electrode, wherein

the working electrode, counter electrode, and reference electrode are all formed on an insulating substrate, and

an enzyme electrode comprising at least an immobilized enzyme film layer disposed on the surface of the working electrode is used for the current detection.

20 (currently amended): The method according to claim 9, wherein said chemical sensor is an amperometric chemical sensor-which has three electrodes including the counter electrode in addition to the working electrode and the reference electrode, wherein

the working electrode, counter electrode, and reference electrode are all formed on an insulating substrate, and

an enzyme electrode comprising at least an immobilized enzyme film layer disposed on the surface of the working electrode is used for the current detection.